ABSTRACT OF THE DISCLOSURE

The efficiency of a combination reformer/fuel cell system is significantly improved by recapturing the energy value of heat generated in the fuel cell and producing additional power. The cooling water from the fuel cell is mixed, entirely or in part, with sufficient or excess compressed air, and at least partially evaporates in the compressed air. The air is at least sufficient to support the oxidative reactions in the fuel cell and also to serve as oxidant in a burner that provides heat to reform fuel/steam mixtures into hydrogen-containing reformate. This air /steam mixture, after leaving the fuel cell, is further heated by heat exchange with the reformate stream and reformate-producing modules, and with the exhaust stream of the burner. The steam/air mixture is injected into the burner, optionally after superheating in the burner exhaust, and is reacted with fuel in the burner. The burner exhaust may be used to provide heat to a fuel reforming reaction. The high-temperature burner exhaust may also be used to drive an expander, preferably a turbine, at a location in the system which is downstream of the burner, but in which the exhaust is at a high temperature so as to run the turbine efficiently. The turbine recovers heat energy from the fuel cell as mechanical energy, typically in excess of the energy required to run a compressor, because of the addition of steam to the compressed air. Moreover, system heat removal elements, such as radiators, as well as overall system size and cost, can be markedly reduced for a given level of output.